Calculating Total Resistance

Resistances in Series.

When more than one resistor is used in series in an electrical circuit, the total resistance is found by summing the individual resistances. If the resistances are called R_1, R_2, R_3, etc., as shown in Figure 1-3, then the total resistance is

$$R_{TOTAL} = R_1 + R_2 + R_3 + \ldots$$

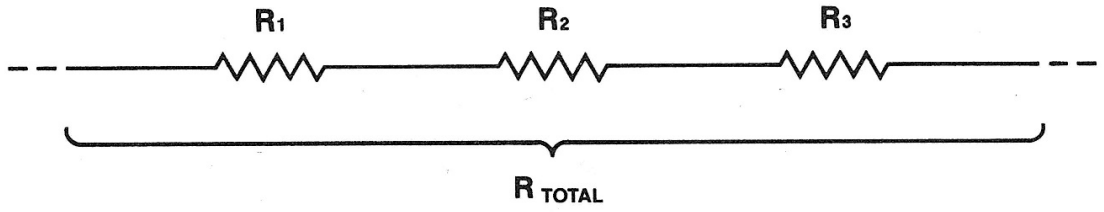

Figure 1-3. Resistance in Series

Resistances in Parallel

When more than one resistor is used in parallel in an electrical circuit, as shown in Figure 1-4, then the total resistance is found by

$$R_{TOTAL} = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2} + \frac{1}{R_3} + \ldots}$$

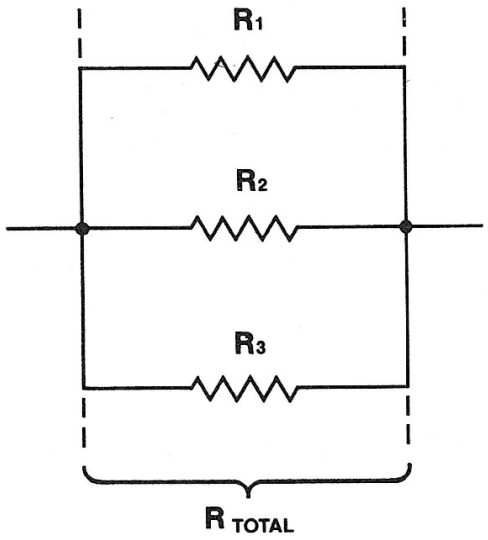

Figure 1-4. Resistance in Parallel

When only two resistors are used in parallel, this formula may be used

$$R_{TOTAL} = \frac{R_1 \times R_2}{R_1 + R_2}$$

When two resistances are used in parallel, the nomograph shown in Figure 1-5

may also be used to quickly calculate total resistance. To use the nomograph, find the first resistance value (R_1) on the left-hand R1 axis and the second resistance value (R_2) on the right-hand axis. Connect these points by a straight-edge. The intersection on the R_{TOTAL} axis is the total resistance. Ignore zeroes when using smaller resistances or add zeroes when using larger resistances. The example shown also holds true for resistors of 15 and 8 ohms (result is 5.2) and 150,000 and 80,000 ohms (result is 52,000 ohms). However, both ranges must be the same (the result is *not* 5,2000 ohms for 15,000 ohms and 80,000 ohms).

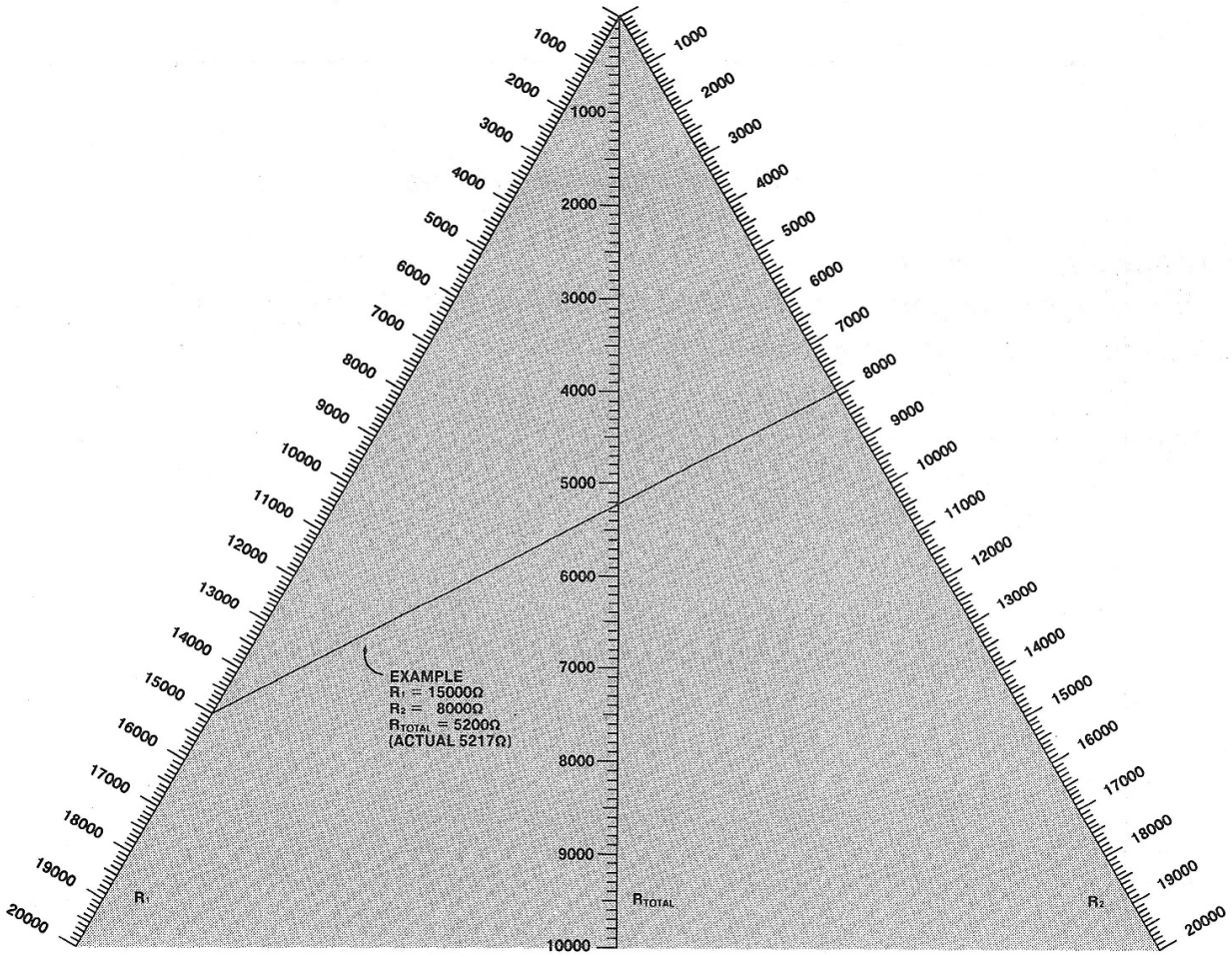

Figure 1-5. Parallel Resistance Nomograph

If the total resistance required is known, find the resistance on the R_{TOTAL} axis and pivot the straight-edge about this point to find resistor combinations that will the required total value.

Resistances in Series-Parallel.

When resistances are in combinations of serial and parallel, as shown in Figure 1-6, calculate the total resistance by breaking the circuit into parts and employing the series and parallel rules.

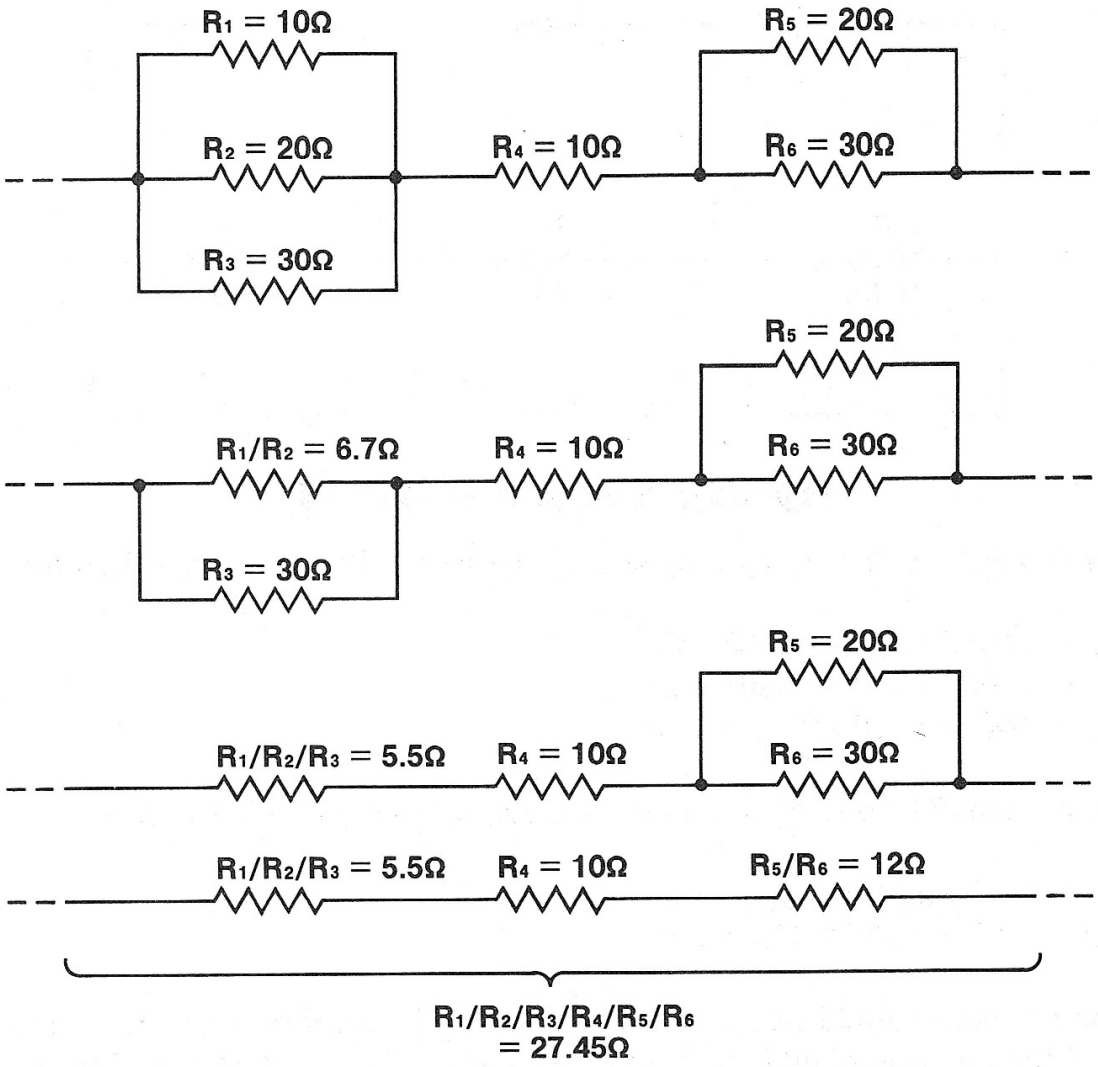

Figure 1-6. Series/Parallel Resistance Example

Example: In the circuit shown, the total resistance of R1 and R2 is 6.7 ohms, from the parallel resistance nomograph. The total resistance of R1/R2/R3 is therefore 5.5 ohms, again from the nomograph. The total resistance of R5 and R6 is 12 ohms from the nomograph, making the grand total resistance 27.5 ohms (5.5 + 10 + 12 ohms)